

What is claimed is:

1. A method of displaying a fluorescence image, wherein operation processing is performed on a first fluorescence image having been obtained by detecting fluorescence components of fluorescence having been produced from living body tissues exposed to excitation light, which fluorescence components have wavelengths falling within a specific wavelength region, and at least either one of a second fluorescence image having been obtained by detecting fluorescence components of the fluorescence, which fluorescence components have wavelengths falling within a wavelength region different from the specific wavelength region, and a reflected reference light image having been obtained by detecting reflected reference light, which has been reflected from the living body tissues when reference light is irradiated to the living body tissues, a tissue condition image, which represents a tissue condition of the living body tissues and which has been compensated for a distance to the living body tissues, is formed with the operation processing, and the thus formed tissue condition image is displayed, the method comprising the steps of:

i) making a judgment as to whether each of image areas embedded in the tissue condition image is an abnormal light affected area, which has been affected by light having an intensity equal to at least a specified value, or a normal light detection area, which has been formed with light having an intensity lower than the specified value, the judgment being made in accordance with

at least one image, which is among the first fluorescence image, the second fluorescence image, and the reflected reference light image, and

ii) displaying the abnormal light affected area in a form different from the normal light detection area.

2. An apparatus for displaying a fluorescence image, wherein operation processing is performed on a first fluorescence image having been obtained by detecting fluorescence components of fluorescence having been produced from living body tissues exposed to excitation light, which fluorescence components have wavelengths falling within a specific wavelength region, and at least either one of a second fluorescence image having been obtained by detecting fluorescence components of the fluorescence, which fluorescence components have wavelengths falling within a wavelength region different from the specific wavelength region, and a reflected reference light image having been obtained by detecting reflected reference light, which has been reflected from the living body tissues when reference light is irradiated to the living body tissues, a tissue condition image, which represents a tissue condition of the living body tissues and which has been compensated for a distance to the living body tissues, is formed with the operation processing, and the thus formed tissue condition image is displayed, the apparatus comprising:

i) judgment means for making a judgment as to whether each of image areas embedded in the tissue condition image is an abnormal light affected area, which has been affected by light

having an intensity equal to at least a specified value, or a normal light detection area, which has been formed with light having an intensity lower than the specified value, the judgment being made in accordance with at least one image, which is among the first fluorescence image, the second fluorescence image, and the reflected reference light image, and

ii) abnormal light affected area displaying means for receiving an output from the judgment means and displaying the abnormal light affected area in a form different from the normal light detection area in accordance with the output received from the judgment means.

3. An apparatus for displaying a fluorescence image as defined in Claim 2 wherein the specified value is determined in accordance with an intensity of the reflected reference light, which intensity indicates the presence of regularly reflected light, in the reflected reference light image.

4. An apparatus for displaying a fluorescence image as defined in Claim 2 wherein the specified value is determined in accordance with a limit of the detection in at least one image, which is among the first fluorescence image, the second fluorescence image, and the reflected reference light image.

5. An apparatus for displaying a fluorescence image as defined in Claim 2 wherein the specified value is determined in accordance with a limit of an effective measurement range in at least one image, which is among the first fluorescence image, the second fluorescence image, and the reflected reference light

image.

6. An apparatus for displaying a fluorescence image as defined in Claim 2, 3, 4, or 5 wherein the abnormal light affected area displaying means displays the abnormal light affected area in the form different from the normal light detection area only in cases where the tissue condition image is displayed as a still image.

7. An apparatus for displaying a fluorescence image as defined in Claim 2, 3, 4, or 5 wherein the tissue condition image represents a fluorescence yield.

8. An apparatus for displaying a fluorescence image as defined in Claim 2, 3, 4, or 5 wherein the tissue condition image represents a normalized fluorescence intensity.

9. An apparatus for displaying a fluorescence image as defined in Claim 4 wherein at least one image, which is among the first fluorescence image, the second fluorescence image, and the reflected reference light image, is obtained from photoelectric detection of light with an image sensor, and

the limit of the detection corresponds to a saturation value of an output of the image sensor.

10. An apparatus for displaying a fluorescence image as defined in Claim 5 wherein a calculation is made to find a mean value of detected values of at least either one of the first fluorescence image and the second fluorescence image, which have been obtained by detecting the fluorescence having been produced from normal tissues when the excitation light is irradiated to

the normal tissues spaced apart by a predetermined distance from an excitation light radiating-out point, and

the specified value in accordance with the limit of the effective measurement range is determined in accordance with a value, which is obtained by adding a value representing a variation of the detected values to the thus calculated mean value.

11. An apparatus for displaying a fluorescence image as defined in Claim 2, 3, 4, 5, 9, or 10 wherein the abnormal light affected area displaying means displays the abnormal light affected area as a color area in cases where the normal light detection area is displayed as a monochromatic area, and

the abnormal light affected area displaying means displays the abnormal light affected area as a monochromatic area in cases where the normal light detection area is displayed as a color area.

12. An apparatus for displaying a fluorescence image as defined in Claim 2, 3, 4, 5, 9, or 10 wherein the abnormal light affected area displaying means displays the abnormal light affected area as a blinking area.

13. An apparatus for displaying a fluorescence image as defined in Claim 2, 3, 4, 5, 9, or 10 wherein the apparatus further comprises displaying change-over means for manually changing over between an abnormal light affected area displaying mode and an abnormal light affected area non-displaying mode.

14. An apparatus for displaying a fluorescence image as defined in Claim 2, 3, 4, 5, 9, or 10 wherein the apparatus

is constituted as an endoscope system provided with an endoscope tube to be inserted into a living body.

15. An apparatus for displaying a fluorescence image as defined in Claim 2, 3, 4, 5, 9, or 10 wherein the apparatus further comprises a light source for producing the excitation light, and the light source is a GaN type of semiconductor laser.

16. A method of acquiring an endoscope image, comprising the steps of:

i) irradiating light to living body tissues,  
ii) detecting reflected light, which has been reflected from the living body tissues when the light is irradiated to the living body tissues, as an image, and

iii) acquiring a reflection image from the image, which has been obtained by detecting the reflected light,

wherein the reflection image is acquired by performing low-pass filtering processing on the image, which has been obtained from the detection of the reflected light.

17. A method of acquiring an endoscope image, comprising the steps of:

i) irradiating light to living body tissues,  
ii) detecting reflected light, which has been reflected from the living body tissues when the light is irradiated to the living body tissues, as an image, and

iii) acquiring a reflection image from the image, which has been obtained by detecting the reflected light,

wherein the reflection image is acquired by:

performing differentiation filtering processing  
on the image, which has been obtained from the detection of the  
reflected light, in order to specify a regular reflection image  
area, which is embedded in the image having been obtained from  
the detection of the reflected light and is affected by regularly  
reflected light of the light having been irradiated to the living  
body tissues, and

substituting an image value within the regular  
reflection image area by a corrected value, which is determined  
in accordance with image values at an area surrounding the regular  
reflection image area.

18. A method of acquiring an endoscope image,  
comprising the steps of:

- i) irradiating light to living body tissues,
- ii) detecting reflected light, which has been  
reflected from the living body tissues when the light is irradiated  
to the living body tissues, as an image, and
- iii) acquiring a reflection image from the image, which  
has been obtained by detecting the reflected light,

wherein the irradiation of the light is performed from  
two different positions and with different timings,

the reflected light, which has been reflected from the  
living body tissues when the light is irradiated from one of the  
two different positions to the living body tissues, and the  
reflected light, which has been reflected from the living body  
tissues when the light is irradiated from the other position to

the living body tissues, are detected respectively as two images,  
and

the reflection image is acquired by:

calculating a difference between the two detected  
5 images in order to specify regular reflection image areas, which  
are embedded respectively in the two detected images and are  
affected by regularly reflected light of the light having been  
irradiated to the living body tissues,

10 substituting an image value within each of the  
regular reflection image areas, which are embedded respectively  
in the two detected images, by a corrected value, which is determined  
in accordance with image values at an area surrounding the  
corresponding regular reflection image area, and

15 adding two images, which have been obtained from  
the substitution, to each other.

19. A method of acquiring an endoscope image,  
comprising the steps of:

i) irradiating light to living body tissues,  
ii) detecting reflected light, which has been  
20 reflected from the living body tissues when the light is irradiated  
to the living body tissues, as an image, and

iii) acquiring a reflection image from the image, which  
has been obtained by detecting the reflected light,

25 wherein the irradiation of the light is performed from  
two different positions and with different timings,

the reflected light, which has been reflected from the



living body tissues when the light is irradiated from one of the two different positions to the living body tissues, and the reflected light, which has been reflected from the living body tissues when the light is irradiated from the other position to the living body tissues, are detected respectively as two images, and

the reflection image is acquired by:

performing low-pass filtering processing on each of the two detected images, and

adding two images, which have been obtained from the low-pass filtering processing, to each other.

20. An apparatus for acquiring an endoscope image, comprising:

i) irradiation means for irradiating light to living body tissues,

ii) detection means for detecting reflected light, which has been reflected from the living body tissues when the light is irradiated to the living body tissues, as an image, and

iii) image acquiring means for acquiring a reflection image from the image, which has been obtained by detecting the reflected light,

wherein the image acquiring means acquires the reflection image by performing low-pass filtering processing on the image, which has been obtained from the detection of the reflected light.

21. An apparatus for acquiring an endoscope image as

defined in Claim 20 wherein the low-pass filtering processing is one-dimensional low-pass filtering processing.

22. An apparatus for acquiring an endoscope image as defined in Claim 20 wherein the low-pass filtering processing is two-dimensional low-pass filtering processing.

23. An apparatus for acquiring an endoscope image, comprising:

i) irradiation means for irradiating light to living body tissues,

ii) detection means for detecting reflected light, which has been reflected from the living body tissues when the light is irradiated to the living body tissues, as an image, and

iii) image acquiring means for acquiring a reflection image from the image, which has been obtained by detecting the reflected light,

wherein the image acquiring means acquires the reflection image by:

performing differentiation filtering processing on the image, which has been obtained from the detection of the reflected light, in order to specify a regular reflection image area, which is embedded in the image having been obtained from the detection of the reflected light and is affected by regularly reflected light of the light having been irradiated to the living body tissues, and

substituting an image value within the regular reflection image area by a corrected value, which is determined

in accordance with image values at an area surrounding the regular reflection image area.

24. An apparatus for acquiring an endoscope image as defined in Claim 23 wherein the differentiation filtering processing is one-dimensional differentiation filtering processing.

25. An apparatus for acquiring an endoscope image as defined in Claim 23 wherein the differentiation filtering processing is two-dimensional differentiation filtering processing.

26. An apparatus for acquiring an endoscope image, comprising:

i) irradiation means for irradiating light to living body tissues,

ii) detection means for detecting reflected light, which has been reflected from the living body tissues when the light is irradiated to the living body tissues, as an image, and

iii) image acquiring means for acquiring a reflection image from the image, which has been obtained by detecting the reflected light,

wherein the irradiation means irradiates the light from two different positions and with different timings to the living body tissues,

the detection means detects the reflected light, which has been reflected from the living body tissues when the light is irradiated from one of the two different positions to the living

body tissues, and the reflected light, which has been reflected from the living body tissues when the light is irradiated from the other position to the living body tissues, respectively as two images, and

5           the image acquiring means acquires the reflection image by:

calculating a difference between the two detected images in order to specify regular reflection image areas, which are embedded respectively in the two detected images and are affected by regularly reflected light of the light having been irradiated to the living body tissues,

10           substituting an image value within each of the regular reflection image areas, which are embedded respectively in the two detected images, by a corrected value, which is determined in accordance with image values at an area surrounding the corresponding regular reflection image area, and

15           adding two images, which have been obtained from the substitution, to each other.

20           27. An apparatus for acquiring an endoscope image, comprising:

i) irradiation means for irradiating light to living body tissues,

ii) detection means for detecting reflected light, which has been reflected from the living body tissues when the light is irradiated to the living body tissues, as an image, and

25           iii) image acquiring means for acquiring a reflection

image from the image, which has been obtained by detecting the reflected light,

wherein the irradiation means irradiates the light from two different positions and with different timings to the living body tissues,

the detection means detects the reflected light, which has been reflected from the living body tissues when the light is irradiated from one of the two different positions to the living body tissues, and the reflected light, which has been reflected from the living body tissues when the light is irradiated from the other position to the living body tissues, respectively as two images, and

the image acquiring means acquires the reflection image by:

performing low-pass filtering processing on each of the two detected images, and

adding two images, which have been obtained from the low-pass filtering processing, to each other.

28. An apparatus for acquiring an endoscope image as defined in Claim 20, 21, 22, 23, 24, 25, 26, or 27 wherein the apparatus further comprises excitation light irradiating means for irradiating excitation light to the living body tissues, the excitation light causing the living body tissues to produce fluorescence, and fluorescence image detecting means for detecting the fluorescence, which has been produced from the living body tissues when the excitation light is irradiated to the living

body tissues, as a fluorescence image, and

the image acquiring means acquires a fluorescence yield image in accordance with a ratio of the fluorescence image to the reflection image.

5           29. An apparatus for acquiring an endoscope image as defined in Claim 28 wherein the reflection image is an image formed with reflected light of the excitation light.

10           30. An apparatus for acquiring an endoscope image as defined in Claim 28 wherein the reflection image is an image formed with reflected light of near infrared light, which has been irradiated by the irradiation means to the living body tissues.

15           31. An apparatus for acquiring an endoscope image as defined in Claim 28 wherein the reflection image is an image formed with reflected light of light, which has wavelengths falling within a red wavelength region and has been irradiated by the irradiation means to the living body tissues.

20           32. An apparatus for acquiring an endoscope image as defined in Claim 28 wherein the reflection image is an image formed with a luminance signal having been formed in accordance with the reflected light of the light, which has been irradiated by the irradiation means to the living body tissues.